FOSSIL BIRDS OF THE LATE PLIOCENE OF CITA CANYON, TEXAS

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Among the extensive collections of vertebrate fossils assembled by the late C. Stuart Johnston from the panhandle of Texas was a small number of bird remains. These, which total 9, are from the locality known as Cita Canyon. This material is now deposited partly in the Museum of Paleontology of the University of California and partly in the collection of the Panhandle Plains Historical Museum at Canyon, Texas. Dr. Donald E. Savage has kindly made it available for study.

The Cita Canyon locality, no. V-3721 Univ. Calif. Mus. Paleo., is 3½ miles south and 13 miles east of Canyon, Randall County, Texas. It is situated on the Newton Harrell-Edd Ranch. The sediments are sandstones of lacustrine or playa origin. The deposits and mammalian assemblage of this locality (Johnston and Savage, 1955) are of Blancan age which is classed by Wood *et al.* (1941) as late Pliocene.

Description of Material

Family Threskiornithidae

Plegadis gracilis, new species

Type.—Left tarsometatarsus, including proximal end and shaft, 44 mm. in length, and lacking medial calcanial ridge of hypotarsus; well preserved; no. 45088 Univ. Calif. Mus. Paleo.; fig. 1 *d*, *e*.

Referred material.—Right carpometacarpus, lacking most of central segment of metacarpal III; well preserved, the appearance of the fossilization being identical with that of the type; no. 3170 Panhandle Plains Hist. Mus. Left ulna, including distal end and shaft, 43 mm. in length; well preserved; no. 3171 Panhandle Plains Hist. Mus.

Diagnosis.—Similar in configuration to both *Eudocimus albus* and *Plegadis mexicana* but tarsometatarsus smaller (Table 1), at least 12 per cent less in width across cotylae.

The tarsometatarsus is referred to the family Threskiornithidae on the basis of general agreement in configuration of the hypotarsus, which in all three genera studied *(Eudocimus, Plegadis,* and *Theristicus)* shows a consolidated basal stalk, not perforated by tendinal canals but supporting an open tendinal groove. In the one specimen of *Theristicus* with which comparison was made, there is a very thin bony bridge over the single canal. In all genera of the Ardeidae and Cochlearidae examined, the basal hypotarsal stalk is perforated or deeply cut with two tendinal canals. The non-perforate hypotarsus is also found in the families Phoenicopteridae and Ciconiidae, but the fossil is markedly smaller and shows differences in details of configuration from them.

The carpometacarpus is assigned to the family Threskiornithidae on the

basis of general agreement in configuration to the genera *Eudocimus* and *Plegadis* and particularly the presence of a short "tendinal ridge" located in the middle of the anconal groove of the distal metacarpal symphysis, in line with the process for digit III. There is close familial accord in proportion, especially in the ratio of the length of the distal carpometacarpal symphysis to the total length of the carpometacarpus (Table 2), which is generally of a higher value in the family Threskiornithidae than in the families Ardeidae, Cochlearidae, and Ciconiidae. Comparative osteological material was not available for the families Scopidae and Balaenicipitidae. Recent New World genera of Phoenicopteridae show a value for the "symphysis ratio" slightly greater than that of *Eudocimus* and *Plegadis*, and also the carpometacarpus of the phoenicopterids is of much larger size.

The distal end of the fossil ulna shows no diagnostic features but is of the same general size as the two other fossil elements; therefore it is referred to the same species.

TABLE 1

MEASUREMENTS IN MILLIMETERS OF THE TARSOMETATARSUS AND CARPOMETACARPUS OF FOUR SPECIES OF THE THRESKIORNITHIDAE

Species	Tarsometatarsus				Carpometacarpus		
	Total length	Narrowest medio-lateral width of shaft	Cotylar width	Antero-posterior width of proximal end[1]	Total length	Width of proximal head	Width of distal head
Theristicus caudatus	92.3	5.9	15.2	11.7	73.4	18.0	10.8
	79.2	5.5	14.3	11.0	68.4	16.8	10.4
Plegadis mexicana	113.1	4.3	11.1	11.3	58.0	11.6	7.3
	87.6	3.7	9.1	9.4	50.7	10.0	6.5
	87.5	3.7	9.2	9.3	50.6	10.2	6.8
Eudocimus albus	83.6	4.3	10.2	10.3	57.2	12.5	7.5
	77.7	4.3	10.4	9.1	51.4	11.6	7.2
Plegadis gracilis	–	3.4	8.0	7.9	45.3	9.5	5.7

[1] Measurement taken from anterior surface of lateral cotyla to posterior edge of lateral hypotarsal ridge.

Because skeletal material was available for only three of the 17 genera of the Threskiornithidae listed by Peters (1931), namely *Guara (Eudocimus)*, *Plegadis*, and *Theristicus*, it was necessary to utilize the measurements of wing and tarsus obtained from study skins to eliminate certain genera from consideration on the basis of size alone. Table 3 lists the species which approach the small size of modern *Plegadis* and *Eudocimus* most closely in length of wing or length of tarsus or both. Whereas *Lampribis*, *Harpiprion*, and *Mesembrinus* possess a short tarsus, possibly as short as the fossil, the

TABLE 2

RATIO OF LENGTH OF DISTAL METACARPAL SYMPHYSIS TO TOTAL LENGTH OF CARPOMETACARPUS IN 19 GENERA OF THE CICONIIFORMES

Family	Genus	Ratio
Phoenicopteridae	*Phoenicopterus*	.156
	Phoenicoparrus	.173
Threskiornithidae	*Eudocimus*	.141
	Plegadis	.146
	Theristicus	.117
	Plegadis gracilis	.161
Ardeidae	*Ardea*	.104
	Casmerodius	.117
	Heterocnus	.101
	Botaurus	.119
	Nyctanassa	.106
	Egretta	.114
	Nycticorax	.102
	Hydranassa	.104
	Florida	.103
	Butorides	.106
	Leucophoyx	.111
	Ixobrychus	.124
Cochleariidae	*Cochlearius*	.112
Ciconiidae	*Mycteria*	.083

wing measurements of these three genera and also *Phimosus* suggest a relatively longer carpometacarpus than in the fossil. If *Lampribis*, *Harpiprion*, and *Mesembrinus* are of general build and wing length similar to *Eudocimus* and *Plegadis*, even though short-legged, we may presume that the tarsus would be short but broad and thus not slender as in the fossil.

With respect to the two genera *Eudocimus* and *Plegadis*, the fossil is similar to both of these in the relative slimness of the hypotarsal stalk but it appears to be more closely related to *Plegadis* in size (Table 1). *Theristicus* not only differs significantly in general size from *Plegadis* and *Eudocimus*, but it also lacks the medial "tendinal ridge," possesses a broader hypotarsal stalk, and shows a much larger value for the "symphysis ratio."

Wetmore in 1940 listed no fossil records of *Plegadis*, *Guara* (*Eudocimus*), or *Ajaia* prior to the Pleistocene of North America. The same author later (1944:92) called attention to a fragment of a coracoid from the Upper Pliocene of Kansas which he tentatively relates to *Plegadis* but which was "from one-fourth to one-eighth smaller than the modern white and scarlet ibises and the glossy ibises." It may well be that the coracoidal element from Kansas represents the same small extinct species of *Plegadis* here

TABLE 3

MEASUREMENTS OF WING AND TARSUS OF SEVEN SPECIES OF THE THRESKIORNITHIDAE[1]

Species	Wing range in mm.	Tarsus range in mm.
Eudocimus albus	263–298	78–101
Plegadis falcinellus	225–295	85–110
Plegadis ridgwayi	256–304	68– 97
Lampribis rara	270–290	56– 65
Harpiprion caerulescens	279	58
Mesembrinus cayennensis	290–340	60– 65
Phimosus infuscatus	292	–

[1]Data from various sources in literature.

described from fossil beds of similar though slightly later age in Texas, less than 200 miles to the southwest.

INDETERMINATE CICONIIFORM

A left phalanx 1, digit II, no. 3172 Panhandle Plains Hist. Mus., in a good state of preservation and measuring 32.7 mm. in length, appears to belong to the Ciconiiformes on the basis of general configuration and particularly the outline of the metacarpal facet. Although the fossil is almost complete, this element shows insufficient character to permit more than ordinal assignment. On the basis of length and width of the phalanx, the bird presumably was about the size of *Theristicus caudatus* and thus much larger than *Plegadis gracilis*.

FAMILY ANATIDAE

Anas sp.

The distal end and shaft of a left humerus (no. 3173 Panhandle Plains Hist. Mus.) of a teal is well preserved distally and matches closely in configuration and size the distal end of the humerus of *Anas cyanoptera*. The bone is too broad and stout to be confused with *A. carolinensis*, 9 specimens of which have been available for comparison. The fossil in similar fashion differs from two examples of *A. discors*, but *discors* and *cyanoptera* are such closely similar species that we distrust this difference and think that larger samples of *discors* would show overlap in dimensions with the fossil. Since *discors* cannot surely be excluded and since there is a number of small teals in other parts of the world which have not been examined, the fossil should not be designated as to species; nonetheless it probably represents the modern *A. cyanoptera* of the New World. "*Querquedula floridana*" of the Pleistocene has recently been shown (Wetmore, 1955) to belong to the genus *Lophodytes* rather than to *Anas*.

Family Meleagridae

Meleagris leopoldi,* new species

Type.—Right tarsometatarsus, lacking proximal end, tip of spur core, and entire internal trochlea and lateral half of external trochlea; well preserved; no. 45086 Univ. Calif. Mus. Paleo.; fig. 1*c*.

Paratypes.—Right tarsometatarsus, complete except for spur core and small part of hypotarsus; well preserved throughout; no. 3169 Panhandle Plains Hist. Mus.; fig. 1*a*, 1*b*. Short section of shaft of right tarsometatarsus including spur core, the tip of core lacking; no. 45087 Univ. Calif. Mus. Paleo.

Diagnosis.—Similar in general shape to the turkeys *Meleagris gallopavo* and *Parapavo californicus* but spur core more distally situated, less than 40 per cent of length of tarsometatarsus from distal end rather than 41 per cent or greater as in *Meleagris* and *Parapavo*; spur core more medially directed, the angle with anterior surface of shaft less than 59 degrees rather than 62 degrees or greater as in *Meleagris gallopavo* and *Parapavo*. Size similar to *Parapavo californicus*.

Measurements.—Paratypes: total length from intercotylar tubercle through middle trochlea, 138.8 mm.; width across trochleae, 20.9 mm.; width across cotylae, 21.3 mm.; minimum mediolateral transverse diameter of shaft, 8.6 and 8.6 mm. Minimum mediolateral diameter of shaft of type, 8.6 mm.

Referred material.—Distal one-fourth of left tibiotarsus, no. 3174 Panhandle Plains Hist. Mus. This fragment represents a turkey of the same general size as that represented by the tarsometatarsi of *M. leopoldi*. No diagnostic features of specific or generic type are discernible in this part of this element. Because of size and presence in the same formation, no. 3174 is referred to *M. leopoldi*.

Comparative material.—Parapavo, 8 tarsometatarsi with complete spur cores from Pleistocene of Rancho la Brea (Univ. Calif. Mus. Paleo.). *Meleagris gallopavo*, 3 male tarsometatarsi with complete spur cores (Mus. Vert. Zool. no. 119,318; Loye Miller coll. nos. 921 and 2295). *Agriocharis ocellata*, 1 male without spur core (Mus. Vert. Zool. no. 129,318) and 1 male with complete spur core (Loye Miller coll. no. 1743).

The Cita Canyon turkey material was originally assigned to *Parapavo californicus* by Loye Miller (1937) on the basis of correspondence in "size, proportions, elevation of spur core, relative positions of the trochleae, the small intertrochlear foramen on the inner side, the shape of the proximal cotylae and hypotarsus, the incipient hypotarsal third ridge." Of these characters we now find that the elevation of the spur core is different and forms part of the basis for recognizing the Cita Canyon bird as a distinct species. The remaining characters do not now appear to be of service in separating the genera *Parapavo* and *Meleagris*. Size of the order here involved can not serve in generic distinctions as there are many size types among races and species in *Meleagris*. The proportions of length to width of the tarsometatarsus appear similar in the two genera (see Howard, 1927). In the relative position of the trochleae there is considerable overlap with *Meleagris*. The inconstant development of the intertrochlear foramen and

*Named in recognition of the contribution of A. Starker Leopold to the knowledge of the biology of modern turkeys.

the incipient hypotarsal third ridge in *Parapavo* and *M. gallopavo* has already been reported by Howard (*loc. cit.*) and is confirmed by us. We have found no character in the shape of the proximal cotylae which warrants

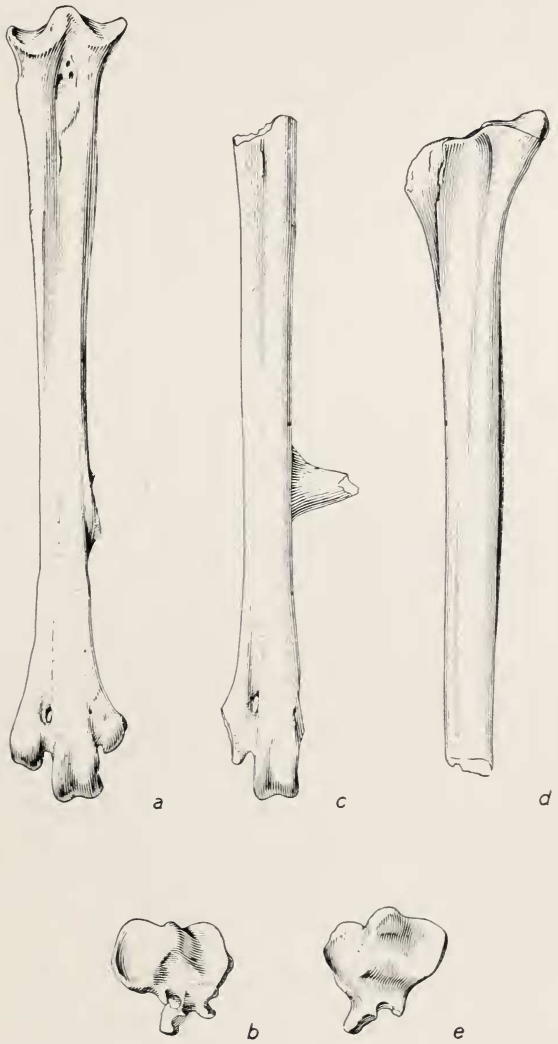

FIG. 1. Fossil birds from Cita Canyon, Texas; drawings by Owen Poe.

a, **b**, paratype of *Meleagris leopoldi*, anterior aspect and proximal articular surface, no. 3169, Panhandle Plains Hist. Mus.; **c**, type of *Meleagris leopoldi*, no. 45086, Univ. Calif. Mus. Paleo.; all $\times$ 3/4.

d, **e**, type of *Plegadis gracilis*, medial aspect and proximal articular surface, no. 45088, Univ. Calif. Mus. Paleo.; both $\times$ 2.

confidence. Thus in none of these particulars nor in any other features of the tarsometatarsus do we find grounds for generic separation of *Parapavo* and *Meleagris*, although there appears to be justification for separation of these genera on the basis of differences in other skeletal elements, particularly the skull (Howard, *op. cit.*), and *Agriocharis* may similarly be separated.

TABLE 1
HEIGHT AND ANGLE OF SPUR CORE IN TURKEYS

Species	Height of spur core as per cent of total length of tarsometatarsus[1]				Angle of spur core[2]			
	No.	Range	Mean	SD	No.	Range	Mean	SD
M. leopoldi	1	–	39.8[3]		2	53.0–58.5		
Parapavo californicus	6	11.7–16.0	12.7	2.01	8	62.0–78.0	68.3	5.13
M. gallopavo	3	11.2–13.1	12.1	1.00	3	63.5–71.5	67.1	4.18
M. crassipes[4]	1	–	15	–	–	–	39	–
Agriocharis ocellata	1	–	36.0	–	–	–	–	–

[1]Height of spur core was measured from the mid-point of the base of spur core to the end of the middle trochlea.

[2]Angle of spur core was determined by preparing plaster casts of tarsometatarsi from moulds composed of gelatin-agar agar mixture. The cast was sectioned transversely through the main axis of the spur core. From a tracing of the outline of the section, the angle of the spur core was measured in the same manner as illustrated by L. Miller (1940).

[3]To obtain this figure, total length of tarsometatarsus was measured on the paratype, whereas height of spur core was measured on the type.

[4]*Fide* L. Miller (*loc. cit.*).

This situation means that there is no basis for the assignment of tarsi such as those from Cita Canyon to *Parapavo* in contradistinction to *Meleagris*. They could relate to either. In the absence of associated diagnostic skeletal elements, such as the skull, it would seem best to carry a species like *leopoldi* in the more inclusive genus *Meleagris* and thereby avoid any implication of special affinity with *Parapavo*. The tarsus of *Agriocharis* seems separable from both *Parapavo* and *Meleagris* on the basis of its slenderness, particularly across the trochleae.

Several fossil species of turkeys previously assigned to *Meleagris* seem to bear no close similarity to *leopoldi*. *M. crassipes* (L. Miller, 1940) from the Pleistocene of San Josecito Cave, Nuevo León, was a small, short-legged species with the spur core situated high, near the middle of the shaft and directed more medially even than in *leopoldi* (see Table 4). *Meleagris superba* from the Pleistocene of New Jersey and Pennsylvania was much longer legged than modern *M. gallopavo* and therefore not like the much smaller *leopoldi*, whereas *Meleagris richmondi* of the Pleistocene of California, based on a sternum, was only about half the size of *M. gallopavo*

and thus too small to be identical with *M. leopoldi*. *Meleagris tridens* of the Pleistocene of Florida had a very distinctive triple spur development. *Meleagris celer* from New Jersey, likewise of the Pleistocene, although much smaller than *superba*, with which Marsh compared it, falls in the general size range of *gallopavo*. On the basis of the tibiotarsus it was claimed (Marsh, 1872) to be slender legged but whether in fact it was so in relation to *gallopavo* and *M. leopoldi* is uncertain as Marsh's measurements of the shaft fall in the range of *gallopavo* as given by Howard (*loc. cit.*: 23). The critical parts of the tarsometatarsus on which *M. leopoldi* is based cannot be compared in *celer*. The latter may indeed prove to be identical with *gallopavo*. The much older *Meleagris antiqua* of the Oligocene of Colorado, although the size of a female *M. gallopavo*, is based on the distal end of the humerus and cannot be compared with *M. leopoldi*. It is not likely to be specifically identical with the late Pliocene and Pleistocene forms.

The particular interest in *Meleagris leopoldi* lies in the further representation through it of turkeys in the Pliocene. Wetmore (1944:98) reported *Meleagris gallopavo* from the Rexroad fauna of the Upper Pliocene of Kansas on the basis of a tibiotarsus; probably on the basis of this element alone *leopoldi* and *gallopavo* could not be differentiated. The meleagrid line had presumably appeared in the Oligocene and diverged by the Pleistocene to form at least two generic types *Meleagris* and *Parapavo*, and probably also *Agriocharis*, known only from the Recent. At least several species of turkeys, of whatever genus, existed in the late Pliocene and the Pleistocene, with a very considerable size range. *M. leopoldi* has no certain phyletic relation to any one of these, although it is close to several of them. Its distinctive location and angulation of the spur core alone set it off from previously known species.

Ecologic and Zoogeographic Considerations

The bird remains from Cita Canyon are of two ecologic types, a water bird assemblage and a terrestrial representative. The ibis (*Plegadis gracilis*), the teal (*Anas*), and the unidentified ciconiiform could have become entombed in any lacustrine situation or river channel pond even if of very limited extent. The turkey (*Meleagris leopoldi*) would have demanded an open woods or scrub cover if not a denser type of vegetation. The avifauna suggests, then, a mixture of woodland and open bordering terrain, with ponds and marshes present.

The very small ibis herein described suggests a fragment of an ibis of similar size previously mentioned as occurring in the Upper Pliocene of Kansas. The ibises as a group are of world-wide occurrence in equatorial and temperate latitudes and the teals are cosmopolitan.

The turkey, herein described as a new species, is now assigned to *Meleagris* rather than to *Parapavo* as formerly. The doubting of its generic affinity with the Pleistocene *Parapavo* leaves the latter restricted in known distribution to the coastal districts of California.

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